

Advanced Supported Liquid Membranes for Ammonia and Formaldehyde Control in Spacesuits, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)



ABSTRACT

With plans to transition to the Rapid Cycle Amine system for CO₂ control in the Portable Life Support System used for extra vehicular activities (EVA), NASA has a need to improve the method for controlling trace contaminants, specifically ammonia (NH₃) and formaldehyde (CH₂O), which have the potential to exceed space craft maximum allowable concentrations (SMAC) by the end of the EVA. A very simple way to remove ammonia and formaldehyde would be with a membrane that would allow ammonia and formaldehyde to escape to space vacuum while retaining oxygen (O₂). Reaction Systems, Inc. (RSI) proposes to develop a supported liquid membrane (SLM) that incorporates a facilitated transport mechanism for the control of ammonia and formaldehyde in spacesuits. An SLM consists of a reactive liquid supported within a porous membrane and takes advantage of the difference in chemical reactivity between the compound of interest and oxygen to achieve the needed selectivity and permeation rate. In addition to reacting with the contaminant, the liquid must have extremely low vapor pressure to prevent loss by evaporation, and it must have low viscosity to allow diffusion across the membrane. As part of the development, RSI will prepare and characterize new functionalized liquid sorbents with near zero vapor pressure, and evaluate their effectiveness for ammonia and formaldehyde removal.

ANTICIPATED BENEFITS

To NASA funded missions:

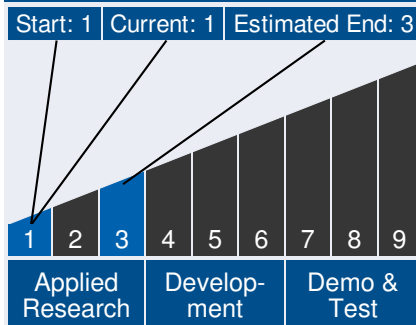
Potential NASA Commercial Applications: The most immediate application of the technology being proposed herein is the control of trace contaminants, like ammonia and formaldehyde, in a space suit. The same technology could also find application for trace contaminant control in spacecraft cabins and on the International Space Station (ISS). Currently, an acid treated, non-regenerable carbon bed is used to remove ammonia. However, a highly selective SLM vented to space would be a



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Technology Maturity



Management Team

Program Executives:

- Joseph Grant
- Laguduva Kubendran

Program Manager:

- Carlos Torrez

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continuous system that demands very little power, with negligible losses of nitrogen or oxygen.

To the commercial space industry:

Potential Non-NASA Commercial Applications: This technology could also find application for trace contaminant control to improve indoor air quality in factories and laboratories. For example, workers are exposed to formaldehyde in the manufacture of formaldehyde-based resins and their use in particleboard products. Morticians and laboratory workers may also be exposed to formaldehyde. Risk of exposure to ammonia is high in the manufacture of fertilizers. For these applications a vacuum pump would be used on the low pressure side to provide the driving force for separation. With the very high selectivity potentially available with an SLM, the flow through the pump would consist primarily of the contaminants and very little oxygen or nitrogen. This would minimize the flow through the pump and therefore the required power.

Management Team (cont.)

Principal Investigator:

- David Wickham

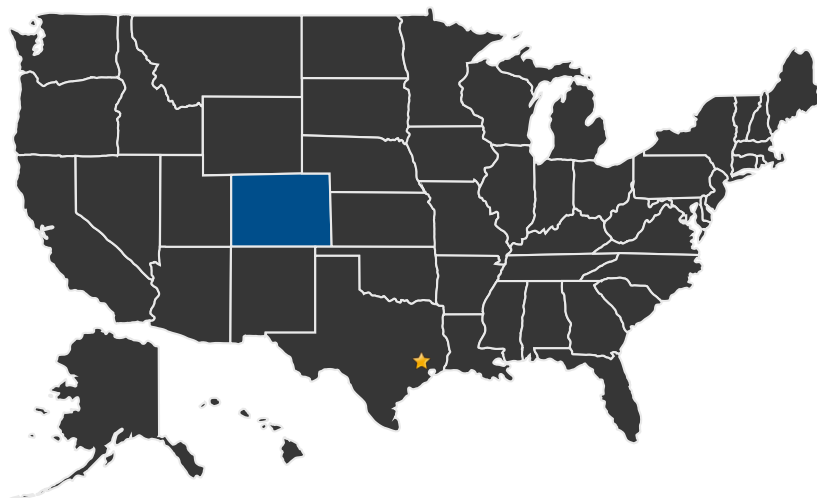
Technology Areas

Primary Technology Area:

Human Health, Life Support, and Habitation Systems (TA 6)

- └ Extravehicular Activity Systems (TA 6.2)
 - └ Portable Life Support System (TA 6.2.2)

U.S. WORK LOCATIONS AND KEY PARTNERS



■ U.S. States
With Work

★ **Lead Center:**
Johnson Space Center

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Other Organizations Performing Work:

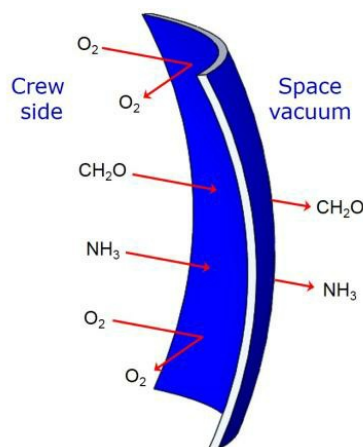
- Reaction Systems, LLC (Golden, CO)

PROJECT LIBRARY

Presentations

- Briefing Chart
 - (<http://techport.nasa.gov:80/file/23246>)

IMAGE GALLERY



*Advanced Supported Liquid
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DETAILS FOR TECHNOLOGY 1

Technology Title

Advanced Supported Liquid Membranes for Ammonia and Formaldehyde Control in Spacesuits, Phase I

Potential Applications

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Station (ISS). Currently, an acid treated, non-regenerable carbon bed is used to remove ammonia. However, a highly selective SLM vented to space would be a continuous system that demands very little power, with negligible losses of nitrogen or oxygen.